Gulf Coast Joint Venture:

Mississippi River Coastal Wetlands Initiative

North American Waterfowl Management Plan

2002

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North American Waterfowl Management Plan

This is one of six reports that address initiative plans for the entire North American Waterfowl Management Plan, Gulf Coast Joint Venture: the Chenier Plain Initiative, the Laguna Madre (Texas) Initiative, the Texas Mid-Coast Initiative, the Coastal Mississippi Wetlands Initiative, the Mobile Bay Initiative, and the Mississippi River Coastal Wetlands Initiative (southeast Louisiana).

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Introduction

North American Waterfowl Management Plan

Faced with continuing wetland destruction and rapidly declining waterfowl populations, the Canadian and U.S. governments signed the North American Waterfowl Management Plan (NAWMP) in 1986, undertaking an intense effort to protect and restore North America's waterfowl populations and their habitats. Updated in 1994 and 1998 with Mexico as a signatory, the NAWMP recognizes that the recovery and perpetuation of waterfowl populations to levels observed in the 1970's, which is the baseline reference for duck population objectives under the plan, depends on restoring wetlands and associated ecosystems throughout the continent. The purpose of the NAWMP is to achieve waterfowl conservation while maintaining or enhancing associated ecological values in harmony with human needs. The benefits of such habitat conservation were recognized to be applicable to a wide array of other species as well. Six priority waterfowl habitat ranges, including the Western U.S. Gulf of Mexico Coast (hereafter Gulf Coast), were identified in the 1986 document and targeted as areas to begin implementation of the NAWMP.

Transforming the goals of the NAWMP into actions requires a cooperative approach to conservation. The implementing mechanisms of the NAWMP are regional partnerships called joint ventures. A joint venture is composed of individuals, corporations, small businesses, sportsmen's groups, conservation organizations, and local, state, provincial, and federal agencies that are concerned with conserving migratory birds and their habitats in a particular physiographic region such as the Gulf Coast. These partners come together under the NAWMP to pool resources and accomplish collectively what is often difficult or impossible to do individually.

Gulf Coast Joint Venture

The Gulf Coast is the terminus of the Central and Mississippi Flyways and is therefore one of the most important waterfowl areas in North America, providing both wintering and migration habitat for significant numbers of the continental duck and goose populations that use both flyways. The coastal marshes of Louisiana, Alabama, and Mississippi regularly hold half of the wintering duck population of the Mississippi Flyway. Coastal wetlands of Texas are the primary wintering site for ducks using the Central Flyway, wintering more than half of the Central Flyway waterfowl population. The greatest contribution of the Gulf Coast Joint Venture (GCJV) region (Fig. 1) in fulfilling the goals of the NAWMP is as a wintering

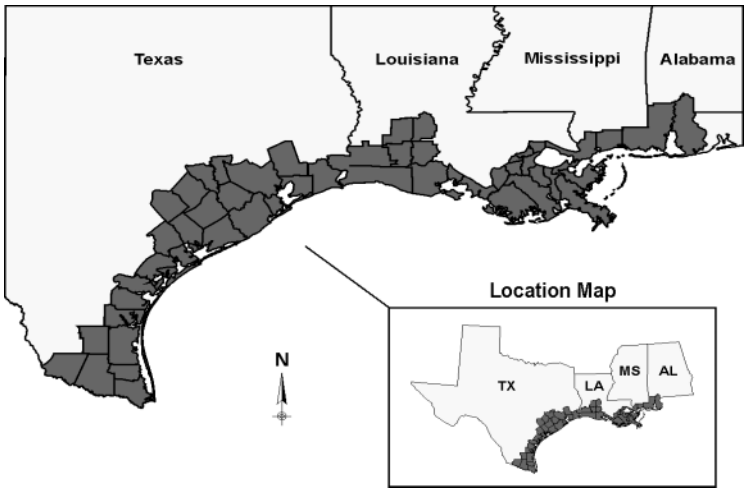


Figure 1. Location of the Gulf Coast Joint Venture region.

ground for waterfowl. The GCJV area also provides year-round habitat for over 90% of the continental population of mottled ducks and serves as a key breeding area for whistling ducks. In addition, hundreds of thousands of waterfowl use the Gulf Coast as stopover habitat while migrating to and from Mexico and Central and South America. The GCJV region is the primary wintering range for several species of ducks and geese and is a major wintering area for every other North American duck except wood ducks, black ducks, cinnamon teal, and some sea ducks (Tribe Mergini).

Through its wetland conservation accomplishments, the GCJV is contributing to the conservation of biological diversity. While providing habitat for waterfowl, especially ducks, continues to be the major focus of the GCJV, a great diversity of birds, mammals, fish, and amphibians also rely on the wetlands of the Gulf Coast for part of their life cycles. Numerous species of shorebirds, wading birds, raptors, and songbirds can be found along the Gulf Coast. Of the 650 species of birds known to occur in the United States, nearly 400 species are found in the GCJV area. Muskrats and nutria have historically been important commercial fur species of the Gulf Coast. Many species of fish, shellfish, and other marine organisms also depend on the gulf coastal ecosystem. Almost all of the commercial fish and shellfish harvested in the Gulf of Mexico are dependent on the area's estuaries and wetlands that are an integral part of coastal ecosystems. The American alligator is an important Gulf Coast region species and is sought commercially and recreationally for its hide and meat.

Gulf Coast Joint Venture Objectives

Conserving Gulf Coast habitats is critical to the overall success of the NAWMP because the area provides extensive wetlands that are vitally important to traditional wintering waterfowl concentrations. The primary goal of the GCJV is to provide for waterfowl in winter and ensure that they survive and return to the breeding grounds in good condition, but not exceeding levels commensurate with breeding habitat capacity as is the case with midcontinent lesser snow and Ross' geese. A secondary goal is to provide ample breeding and postbreeding habitat for resident waterfowl. Actions that will achieve and maintain healthy wetland ecosystems that are essential to waterfowl will be pursued. Wetland conservation actions that will provide benefits to species of fish and wildlife, in addition to waterfowl, will also be supported.

The emergence of the U.S. Shorebird Conservation Plan, Partners in Flight physiographic plans, and the Waterbird Conservation Plan, which address conservation of other North American migratory birds, presents opportunities to broaden and strengthen joint venture partnerships for wetland conservation. As definitive population data and habitat needs are developed for the migratory birds represented in these emerging strategies, areas of mutual concern in wetland ecosystems can be identified. These wetland areas of overlapping interest in the GCJV will be candidate priority sites for the integrated design and delivery of habitat conservation efforts. Although wetland conservation projects cannot be designed to provide maximum benefits for all concerned species, they can be designed to maximize the overlap of benefits between the species groups. This joint venture will strive to balance its focus on waterfowl and wetlands with the need to expand coordination and cooperation with existing conservation initiatives that promote common purposes, strategies, or habitats of interest.

The GCJV is divided geographically into six initiative areas, each with a different mix of habitats, management opportunities, and species priorities. This document deals with planning efforts for the Mississippi River Coastal Wetlands Initiative area of southeast Louisiana (Fig. 2). The goal of the Mississippi River Coastal Wetlands Initiative is to provide wintering and migration habitat for significant numbers of dabbling ducks, diving ducks, and snow geese, as well as year-round habitat for the mottled duck (Table 1).

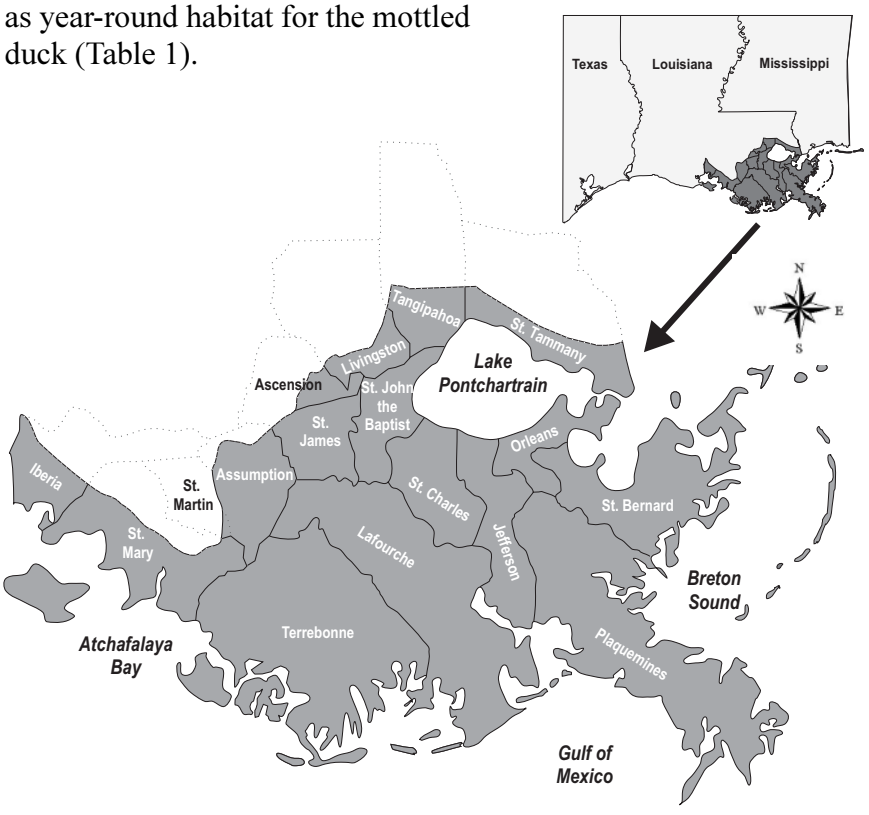


Figure 2. Mississippi River Coastal Wetlands Initiative area (Note: Initiative area, which is shaded in gray, does not follow parish boundaries).

Table 1. Midwinter population objectives[1,2] for initiative areas of the GCJV. (See Derivation of GCJV Waterfowl Objectives and Migration Patterns section of this plan, p. 23, for information about the methods used to develop these goals.)

	Laguna Madre	Texas Mid-Coast	Chenier Plain (Texas)	Chenier Plain (Louisiana)	Mississippi River Coastal Wetlands	Coastal Mississippi Wetlands	Mobile Bay	Total
Mallard	13,530	72,819	44,632	515,895	249,257	619	451	897,203
Northern pintail	173,355	775,755	124,193	396,313	99,967	0	1,236	1,570,819
Gadwall	46,200	224,926	84,039	888,456	714,356	268	2,286	1,960,531
American wigeon	100,377	93,841	29,147	423,845	264,119	191	1,711	913,231
Green-winged teal	35,160	293,574	650,395	951,853	537,313	413	2,544	2,471,250
Blue-winged teal	1,707	23,941	147,053	378,953	723,140	1,738	1,156	1,277,689
Northern shoveler	10,136	127,599	42,988	330,612	103,221	84	0	614,639
Mottled duck[3]	6,595	161,326	89,961	169,544	217,642	397	601	646,067
Canvasback	4,311	33,638	0	23,585	7,516	174	3,025	72,249
Redhead	392,650	92,944	402	0	13,731	0	0	499,727
Ring-necked duck	6,067	11,345	3,331	186,917	41,450	5,999	782	255,890
Greater & lesser scaup[4]	454,727	47,402	40,707	245,746	1,722,858	13,836	3,294	2,528,570
Total ducks	1,244,816	1,959,109	1,256,847	4,511,720	4,694,568	23,719	17,086	13,707,864
Lesser snow geese[3]	30,967	609,879	100,214	279,157	51,614			1,071,831
	25,766	737,403	117,555	437,841	72,250			1,390,815
Greater white-fronted geese[3]	7,759	97,636	7,457	62,529	0			175,381
	13,819	102,790	10,235	77,821	1,233			205,898
Canada geese[3]	6,155	63,043	996	2,000[5]	0			72,194
	430	12,768	957	1,052[5]	0			15,207
Total geese[3]	44,881	770,558	108,667	343,686	51,614	0	0	1,319,406
	40,015	852,961	128,747	516,714	73,483	0	0	1,611,920

[1] Objectives for ducks are based on 1970's winter distributions and breeding populations.

[2] Objectives for geese are based on 1982-88 averages of December Goose Surveys.

[3] Shaded values are "expected" numbers from 1994-97 (mottled ducks) or 1995-97 (geese) estimates.

[4] Scaup objectives exclude offshore populations.

[5] January ground counts indicate historical (1986-89) and recent (1996-98) averages of 5,273 and 10,267, respectively.

Midwinter Duck Population Objectives

To obtain objectives for midwinter duck populations in the GCJV Initiative areas, we started with the NAWMP continental breeding population goals, which total 62 million and are based on averages of 1970's breeding population surveys with adjustments for birds in nonsurveyed areas. We then estimated, from nationwide midwinter survey data proportions, the numbers of those 62 million breeding ducks that should return on spring flights from the Mississippi and Central Flyway wintering areas; we adjusted those numbers for 10% January-to-May mortality to obtain midwinter goals for the Mississippi and Central Flyways. Finally, using 1970's midwinter survey data proportions from the Mississippi and Central Flyways, we calculated how much of each of the two flyway goals should be derived from each GCJV Initiative area. Figure 3 provides an example of how this general process was applied at the species level in the Mississippi River Coastal Wetlands Initiative area. Exceptions to this methodology include derivation of blue-winged teal and redhead objectives and the expected number of mottled ducks (see Derivation of GCJV Waterfowl Objectives and Migration Patterns section, p. 23).

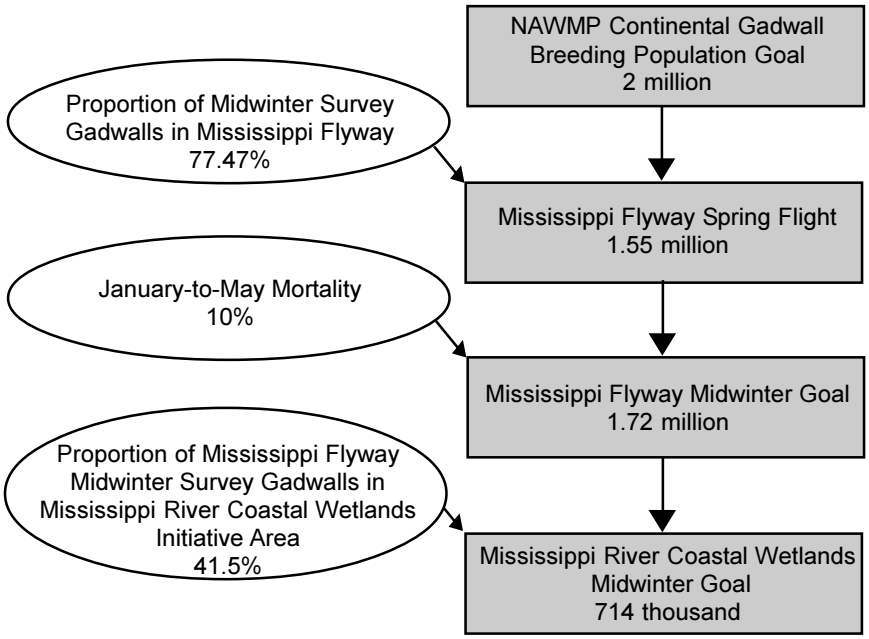


Figure 3. An example of how midwinter population objectives for a specific species, in this case gadwalls, were obtained in the Mississippi River Coastal Wetlands Initiative area.

Midwinter Goose Population Objectives

Midcontinent lesser snow and Ross' geese, many of which spend winters in the GCJV, are exceeding their Canadian breeding habitat capacity to the detriment of their long-term health and the health of a myriad of other birds that share their arctic/subarctic breeding habitat. Greater white-fronted geese, as well as Canada geese in some GCJV regions, are also experiencing winter population increases. Therefore, regional goose objectives are expressed two ways. Recent population data are used to estimate a quantity of geese "expected" to occur and compete to some extent for finite resources, whereas actual objectives indicate the desired regional goose population. Both are based on indices from midwinter (December) surveys. "Expected" numbers are derived by averaging recent December surveys (1995-97), and actual objectives are derived from the 1982-88 average (Table 1).

Migration Chronology

Midwinter populations do not adequately represent the peak, or even the typical numbers of some waterfowl species common to the GCJV. Because of the variety of GCJV waterfowl and the interspecific variability in their

migration patterns, incorporating species-specific migration patterns into population objectives is appropriate. Migrations differ regionally, even for the same species, so migration patterns were determined separately for each initiative area (see Migration Chronology for Waterfowl Species of GCJV Initiative Areas section, p. 26). Combining migration patterns and midwinter duck objectives (see Derivation of GCJV Waterfowl Objectives and Migration Patterns section, p. 23) yields semimonthly population objectives by species (Fig. 4). Similarly, combining goose migration patterns with expected numbers of midwinter geese yields semimonthly expected numbers of geese (Fig. 4).

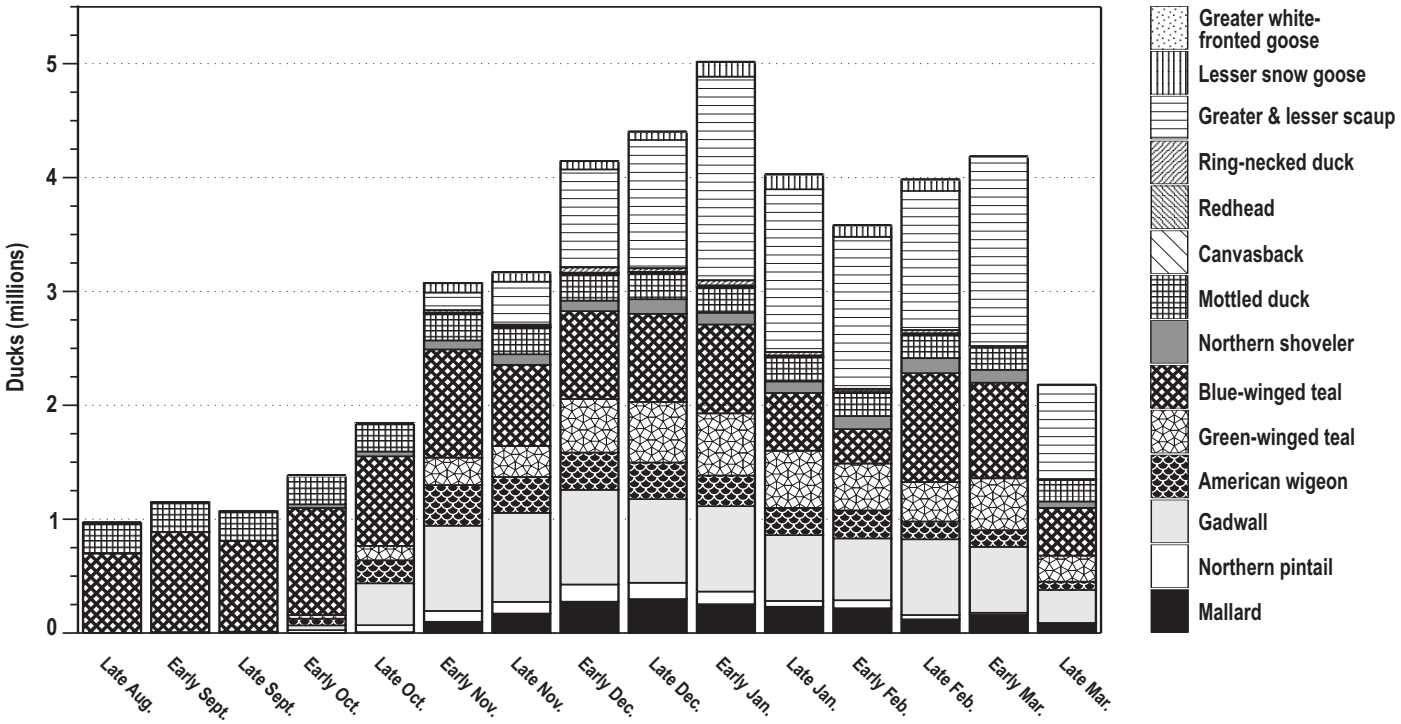


Figure 4. Semimonthly duck population objectives and expected numbers of geese for the Mississippi River Coastal Wetlands Initiative area.

The Mississippi River Coastal Wetlands Initiative Area

The Mississippi River Coastal Wetlands Initiative area is bounded on the east by the Louisiana state line and extends westward to Vermilion Bay. It includes extensive marshland dominated by salt and brackish marshes with numerous large, open water bays and barrier islands. Although the northern boundary occurs at roughly the marsh-swamp interface, the region extends far enough inland to include a fringe of swampland south and east of Louisiana State Highways 90, 70, and 22 and Interstate 12. Of particular significance to regional waterfowl populations are two major river deltas—the Mississippi and the Atchafalaya—dominated by fresh marsh. The Mississippi River Coastal Wetlands Initiative area includes all or portions of 17 Louisiana parishes. See the June 1990 Mississippi River Coastal Wetlands Initiative Plan for a description of the area's geology, climate, and land use.

Although the Mississippi River Coastal Wetlands Initiative area consists of a variety of land types and wildlife habitats, this plan focuses on the three major waterfowl habitats available: coastal marshes, forested wetlands, and seagrass meadows of Chandeleur Sound.

Coastal Marsh

There are four distinct coastal marsh types in the Mississippi River Coastal Wetlands Initiative area based on plant species composition, which is primarily influenced by species tolerance to water salinity. The four marsh type classifications are salt, brackish, intermediate, and fresh. These marsh types generally occur in bands paralleling the coast that correspond to salinity gradients. Moving inland from the Gulf of Mexico, salt marsh is followed by brackish, intermediate, and fresh marsh. In addition to associations of plant species, each coastal marsh type has characteristic hydrological patterns, soils, and fish and wildlife resources.

Types of Coastal Marsh

Salt Marsh

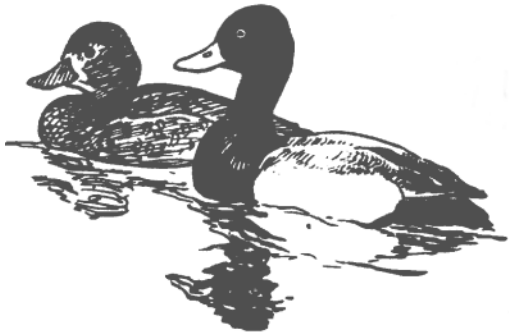
Extensive salt marshes exist in the southern portion of the Mississippi River Coastal Wetlands Initiative area, especially in association with barrier islands; Breton Sound; and Terrebonne, Barataria, and Black Bays. Salt marsh has the greatest tidal fluctuation of the four marsh types in the area and has a well-developed drainage system. Water salinity averages 18 parts per thousand (ppt), and this marsh type supports the least diverse vegetation. The predominant salt-tolerant plants are smooth cordgrass, seashore saltgrass, and needlegrass rush. Salt marsh is generally considered of only low value to waterfowl; however this marsh type buffers the more valuable marsh types farther inland from the impacts of tide and salinity.

Brackish Marsh

Except for narrow zones along the banks of the Mississippi River north of the delta, extensive brackish marshes occur in broad zones inland from the salt marsh. This marsh type is also subjected to daily tidal action. Water salinity averages 8.2 ppt, and plant diversity is greater than that of salt marsh. This marsh

Mallard pair.

type is dominated by saltmeadow cordgrass, seashore saltgrass, Olney bulrush, and widgeongrass. Ponds are also prevalent within brackish marshes, where an abundance of submerged aquatic vegetation varies tremendously among sites and years. Brackish marsh is of high value to gadwalls and greater and lesser scaup, and provides year-round habitat for mottled ducks. This marsh type represents the traditional wintering grounds for lesser snow geese.



Scaup pair.

Intermediate Marsh

Intermediate marsh, which lies inland from brackish marsh, is somewhat influenced by tides, and water salinity averages 3.3 ppt. Plant species diversity is high. This marsh type is also dominated by saltmeadow cordgrass, and other common plants include common reed, bulltongue arrowhead, and coastal waterhyssop. Submerged aquatics such as pondweeds and southern waternymph are abundant in intermediate marsh. This marsh type is used by many species of ducks for feeding and resting. This less saline zone of intermediate marsh provides habitat for mottled duck broods, and use of this marsh type by wintering ducks is second only to fresh marsh.

Fresh Marsh

Fresh marsh in the Mississippi River Coastal Wetlands Initiative area lies between the intermediate marsh and either uplands or forested wetlands. Large areas of fresh marsh also occur at the mouth of the Mississippi and Atchafalaya Rivers. Normally, the tidal range is less in inland marshes, with fresh marsh generally less influenced by tides than more brackish marsh. Water salinity in fresh marsh averages only 1.0 ppt. Fresh marsh supports the greatest diversity of plants. Maidencane, spikerush, bulltongue arrowhead, and alligatorweed are the dominant plants. Many submerged and floating-leafed plants are present in this marsh type. Fresh marsh provides feeding and resting sites to many species of ducks and geese and is considered to be the most valuable marsh type to waterfowl.

Status and Trends

In 1990 marsh acreage of the Mississippi River Coastal Wetlands Initiative area was estimated to be 1,683,600 acres, and marsh composition was 33% fresh, 11% intermediate, 34% brackish, and 22% salt (Louisiana Coastal Wetlands Conservation and Restoration Task Force [LCWCRTF] and the Wetlands Conservation and Restoration Authority [WCRA] 1998). Growth and deterioration of coastal wetlands have been naturally occurring in the Gulf of Mexico region for thousands of years. As wetlands were degraded, their loss was balanced by natural wetland building processes. Coastal wetlands of the Mississippi River Coastal Wetlands Initiative area were created by 5,000 years of active delta building and degradation in alternating regions throughout Louisiana. A sequence of these overlapping deltaic lobes historically spanned from Vermilion Bay to Chandeleur Sound. These lobes alternately served as the active delta as the river periodically changed course and altered distribution of fresh water and sediments. Degrading delta lobes are characterized by an increase in marine

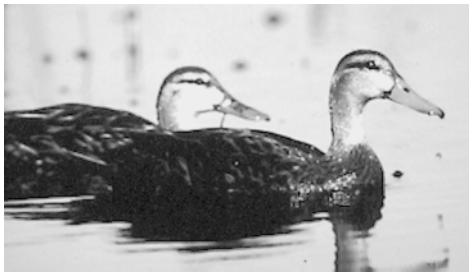
influence and the deterioration of freshwater plants that may be replaced by more salt tolerant species, or result in open water. The gulfward remnants of these degrading lobes typically form a fringe of barrier islands. Prograding or active deltas are characterized by fresh inflows of sediment-laden water, resulting in mudflat deposition that is colonized by emergent vegetation. This naturally cyclic process created a diversity of habitats that benefited a wide variety of fish and wildlife species. Unfortunately, this cyclic balance was permanently interrupted by a variety of human-induced changes, including the channelization of the major distributary outlet that permanently directs the sediments and nutrients of Mississippi River waters to the deep water off the Continental Shelf where it cannot contribute to the marsh-building processes.

Over half of the coastal wetlands for the entire conterminous United States are in the Gulf of Mexico region. Total coastal wetlands for Louisiana account for 12% of the national total and 24% of the regional total (Field et al. 1991).

Louisiana has the highest coastal wetland loss rate of any state in the Nation with currently a loss rate of 25-35 square miles (16,000-22,400 acres) a year. Louisiana's average coastal land loss rate accounts for an estimated 80% of the national total. Coast-wide land loss rates for Louisiana from 1956 to 1978 were estimated to be 39.4 square miles per year (25,200 acres). Although land loss rates in coastal Louisiana were decreasing, losses continued, and the loss rate remained high at 34.9 square miles per year (22,340 acres) for 1978-90. The Mississippi River Coastal Wetlands Initiative area accounted for over 80% of this 1978-90 loss. Most of the loss of emergent wetlands was attributed to the conversion to open water, a much less productive habitat of far less value to ducks.

Wetland Loss Factors and Threats

Wetland loss in the Mississippi River Coastal Wetlands Initiative area can be divided by location into two broad categories: shore and bank erosion and interior loss. Shore and bank erosion is the breakdown of the shorelines of the Gulf Coast and interior lakes and the banks of navigation channels and petroleum access canals. This breakdown is caused by the actions of forces such as natural wave energy, tides, currents, boat wakes, and water surges associated with the passage of large vessels and storms. Erosional forces are exacerbated by relative sea-level rise and hydrologic alterations affecting coarse sediment distribution. The continued effect of these forces gradually wears down the shoreline and bank soils and eventually blows or washes them away. The erosion can be particularly rapid and can cause the direct loss of significant wetland acreage. Shoreline and bank erosion also can dramatically affect wetland loss when it causes hydrologic connections between relatively isolated marsh systems and dynamic water bodies such as navigation channels and large bays.



Mottled duck pair.

Interior marsh loss is caused by a variety of factors. Subsidence and sea-level rise are natural

processes that contribute to marsh deterioration and loss but in some cases have probably been exacerbated by human intervention.

The numerous dredged navigation channels and access canals that criss-cross the coastal marshlands are another cause of interior marsh loss because they have disrupted the natural hydrology of the area. The effects of the disruptions vary, but generally they have created artificial barriers between wetlands and wetland building and maintenance processes, or they have removed natural barriers between wetlands and wetland deterioration processes. The canals and channels facilitate the penetration of salt water far inland into previously fresh marshes, resulting in the death of marsh plants and the eventual erosion or oxidation of organic substrate. Erosion of the substrate is accelerated by the increased water-flow through the marsh as a result of the canals. In addition, the construction of straight canals in areas previously drained by natural channels has increased the speed by which the limited amount of fresh water provided by local rainfall drains seaward. Many canals have high spoil banks that can restrict both the drainage of water from the marsh, which results in excessive ponding, and the delivery of fresh water and sediments to the marsh that are essential for marsh nourishment and maintenance.

Lesser snow geese.

Herbivory by muskrats, nutria, and occasionally geese is believed to be related to some interior wetland loss. The impact of moderate herbivory alone is not enough to cause wetland loss; however, its impact is more pronounced in marshes experiencing additional stresses such as excessive ponding or saltwater intrusion.

Forested Wetlands

Forested wetland ecosystems occur along the northern boundary of the Mississippi River Coastal Wetlands Initiative area. These wetlands are among the most productive natural ecosystems in the world. In their natural condition, forested wetlands provide many benefits including food and habitat for fish and wildlife, flood protection, erosion control, and ground water exchange. In addition, forested wetlands help maintain and improve water quality by intercepting surface water runoff, removing or retaining nutrients (e.g., nitrogen and phosphorus), processing chemical and organic wastes, and reducing sediment loads downstream. However, the loss or degradation of these wetlands can lead to serious consequences including habitat fragmentation, species decline, increased frequency of flooding, and declines in water quality.

The Mississippi River Coastal Wetlands Initiative area encompasses approximately 543,320 acres of wetland habitats dominated by forested swamps and seasonally flooded bottomland hardwoods (LCWCRTF and WCRA 1998). This extensive area of forested wetlands provides habitat for several species of wintering waterfowl. Wood ducks are the primary waterfowl species in these forested wetlands, while other ducks use these habitats to a lesser degree.

Wetland Loss Factors and Threats

From the mid-1970's to the mid-1980's, forested wetlands such as bottomland hardwood swamps and

cypress sloughs declined by 3.1 million acres in the Southeast. In Louisiana, the net loss of palustrine forested wetlands statewide was estimated to be 628,000 acres. Most of this loss occurred in the Mississippi Alluvial Plain, which is primarily to the north of the GCJV area and was primarily caused by agriculture (Hefner et al. 1994). In the Mississippi River Coastal Wetlands Initiative area, saltwater intrusion associated with changes in hydrology and isohaline encroachment is one of the primary causes of forested wetland loss. Over 40% of the existing acreage is expected to be lost over the next 50 years as land use increases and hydrology is altered (LCWCRTF and WCRA 1998).

Seagrass Beds

Seagrass beds (meadows) provide food for wintering waterfowl and important nursery and foraging habitat for several species of commercially important finfish and shellfish. The most prominent of these within the Mississippi River Coastal Wetlands Initiative area exists in an isolated band associated with the Chandeleur Islands barrier island chain. In a study of the Chandeleur Sound, Michot (1997) documented a 19,651-acre seagrass meadow along the back barrier flat on the west side of the 45-mile island chain, where salinity ranged 20-36 ppt.

Five species of seagrasses occur within the Chandeleur Sound: shoalgrass, turtlegrass, manateegrass, star grass, and widgeongrass. Within the Mississippi River Coastal Wetlands Initiative area, nearly all redhead ducks are found in association with the seagrass beds of Chandeleur Sound. Redheads feed almost exclusively on shoalgrass rhizomes while wintering along the Gulf Coast, and widgeongrass also serves as forage for a variety of duck species.

Seagrass Status and Threats

It is estimated that the spatial coverage of seagrasses in the Gulf of Mexico was equivalent to 12-24% of the estuarine area (NOAA 1997). Losses of seagrasses in the northern Gulf of Mexico over the last 50 years have been large—from 20% to 100% for most estuaries (Handley 1995). Most of the loss is attributed to coastal population growth and accompanying municipal, industrial, and agricultural development.

Hurricanes, cold-front storms, and salinity changes are natural causes of seagrass loss and cannot usually be controlled. The loss of seagrasses is also attributable to human-induced effects associated with residential and industrial development pressures. Seagrass meadows are susceptible to the adverse effects of filling in two ways: (1) from direct impacts of filling and (2) from indirect impacts of filling, which include the production of suspended material in the water column (i.e., turbidity). Excess nutrients from sewage treatment discharges, septic systems, and drainage from agricultural fields (i.e., water quality) can stimulate growth of phytoplankton in the waters over the grass beds. Seagrass beds can also be damaged by boat anchors and propellers of shallow draft recreational boats. “Prop scars” may contribute to additional degradation of seagrass beds by accelerating erosion near the broken root mats.

Oil-drilling access canal plug.

Breakwater structures.

Habitat conservation is imperative for meeting waterfowl population objectives of both the NAWMP and the GCJV. The critical habitat conservation needs on public and private lands of the GCJV are to stop and reverse the deterioration and loss of wetlands, especially coastal marshes, and to improve the waterfowl value of agricultural lands. Loss of coastal marsh can be addressed by actions that either reduce the rate of loss or that build land. In the Mississippi River Coastal Wetlands Initiative area, actions addressing the loss of coastal marsh must be based largely on prevention of predictable loss, restoration of degraded areas, and wetland construction.

The availability of food resources is the most likely effect of winter habitat on survival and recruitment of waterfowl populations. Availability of food can be affected by production of foods (submerged aquatics, annual seeds, or invertebrates), flooding at appropriate times and depths for foraging, and access to food influenced by floating exotics, human disturbance, or other factors. In addition to fall and winter food resources, mottled duck populations are influenced by breeding and postbreeding habitat in the Mississippi River Coastal Wetlands Initiative area. Availability of fresh or intermediate shallow water in brood-rearing and molting areas is critical during the spring and summer. Therefore, the habitat conservation actions outlined in this plan intend to influence one or more of these habitat parameters.

Conservation Strategies

Four broad strategies of wetland conservation are important for achieving the goals and objectives of the GCJV. These strategies are maintenance (i.e., loss prevention), restoration, enhancement, and creation of wetland habitat. Though not a strategy, routine management activities are important and inherent components of the restoration and maintenance strategies. Conservation actions under each of these strategies take several forms. The types of wetland conservation actions identified in each initiative area reflect the differences previously discussed that characterize each area. A description of the strategies applicable to the Mississippi River Coastal Wetlands Initiative area is presented below.

Maintenance of Habitat

Maintenance involves preserving existing functions and values of the habitat. The intent is to prevent additional loss and degradation of wetlands, particularly in remaining coastal marshes that are most vulnerable to erosion or conversion to more saline types through saltwater intrusion. Examples of conservation actions under this strategy include the following:

(1) plugging of abandoned oil-drilling access canals to prevent further widening of the canal into emergent marsh;

(2) placing nearshore breakwater structures to reduce or reverse wave erosion on beachfronts into adjacent marsh;

(3) supporting public policy, educational efforts, and sign installation to promote an awareness of the values of seagrass meadows and to avoid mechanical damage from recreational boating activities;

(4) planting erosion control vegetation at key points protecting the hydrologic integrity of vulnerable marshes;
(5) replacing structures and maintaining levees critical to protecting the hydrologic integrity of vulnerable marshes;
(6) implementing managed fire to maintain vegetative communities susceptible to invasion by woody exotics (carefully implemented prescribed burns also increase the availability of belowground foods for geese in their historic marsh range, potentially reducing competition with ducks for food in other habitats);
(7) controlling floating or submersed exotic vegetation to maintain natural plant communities;
(8) implementing forest management plans that maintain the integrity and historical resource values of this ecosystem;
(9) providing technical guidance to achieve the above maintenance measures; and
(10) securing vulnerable tracts through fee title acquisition, conservation easement, or management agreement for implementing the above maintenance measures.

Restoration of Habitat

Restoration involves conservation actions necessary to reestablish a naturally occurring but degraded wetland ecosystem. The goal is to restore or mimic the original wetland functions and values of the site. Examples of conservation actions under this strategy include the following:
(1) restoring historic salinities and hydrology via freshwater diversions;
(2) restoring historic salinities and hydrology to degraded systems through hydrologic structures and levees;
(3) restoring water quality, and subsequently submerged aquatic vegetation productivity, by reducing nutrient loading, fetch, and turbidity;
(4) modifying existing spoil banks and canals to restore hydrology, emergent wetlands, and associated mudflats to their historical condition (e.g., degrading levees and backfilling, plugging, and filling canals);
(5) directing and/or trapping fallout from sediment-laden water to restore mudflats, and ultimately emergent vegetation, on degraded areas;
(6) conducting floating or submersed exotic vegetation control to restore natural plant communities;
(7) beneficially using dredge material from navigation projects to restore emergent wetlands and associated mudflats;
(8) providing technical guidance to achieve the above restorative measures; and
(9) securing degraded tracts through fee title acquisition, conservation easement, or management agreement for the purpose of implementing the above restorative measures.

Creation of Habitat

Creation of habitat is the construction of wetlands where none previously existed in recent geological terms. Conservation actions develop the hydrological, geochemical, and biological components necessary to support and maintain a wetland.

Erosion control vegetation.

Marsh burning.

Hydrologic structure.

Beneficial use of dredge material.

Examples of conservation actions under this strategy include the following:

(1) beneficially using dredge spoil from navigation projects to create emergent wetlands and associated mudflats, and
(2) implementing sediment diversions to create emergent wetlands and associated mudflats.

Habitat Objectives

The three major waterfowl habitats available in the Mississippi River Coastal Wetlands Initiative area are coastal marshes, forested wetlands, and seagrass meadows. Habitat objectives are based on the assumption that food availability is the most likely limiting factor for wintering ducks in the GCJV. Food availability is potentially influenced by factors that affect food production (e.g., marsh health) and access (e.g., disturbance, water at appropriate depths, etc.).

Coastal Marsh

Food density data are not available for coastal marsh habitats of the GCJV, precluding quantitative modeling of habitat needs. However, given the importance of this habitat and its food resources to waterfowl, the enormous loss of coastal marsh, and the limited opportunities for restoration and creation, the GCJV supports all projects that seek to restore lost or degraded marshes to sustainable historic or more natural conditions. The GCJV will be particularly supportive of those restoration and creation projects that will provide the most long-term benefits to waterfowl. Additionally, the GCJV supports all protective measures that maintain current habitat values that would otherwise be predictably lost.

We modeled waterfowl energetic demand on coastal marsh habitats for comparison to forested wetlands. Based on food habits research and general knowledge of habitat use by various species, we estimated the proportion of each species' energetic needs in coastal marsh to be 75% for mallards; 95% for gadwalls, American wigeon, blue-winged and green-winged teal, Northern shovelers, and ring-necked ducks; and 100% for mottled ducks, Northern pintails, and other diving ducks. We estimated that 100% of the geese that occur in Mississippi River coastal wetlands occur in coastal marsh. These estimates result in population objectives for Mississippi River Coastal Wetlands Initiative coastal marsh habitats (Fig. 5). Energetic demand is based on the dietary energy requirements of mallards (Petrie 1994), with other species having energetic needs in proportion to their body weight (Kendeigh 1970). We arrived at an energy demand curve, in terms of mallard-use-days, through the wintering waterfowl period (Fig. 6).

Forested Wetlands

Estimates are available for the density of desirable mast and other waterfowl food sources in forested wetland habitats, so we can model the waterfowl habitat requirements for that particular habitat. Based on food habits research and general knowledge of habitat use by various species, we estimated the proportion of each species' energetic needs in these forested wetland habitats to be 100% for wood ducks; 25% for mallards; and 5% for gadwalls, American wigeon, blue-winged and green-winged teal, Northern shovelers, and ring-necked ducks. We used recent estimates of

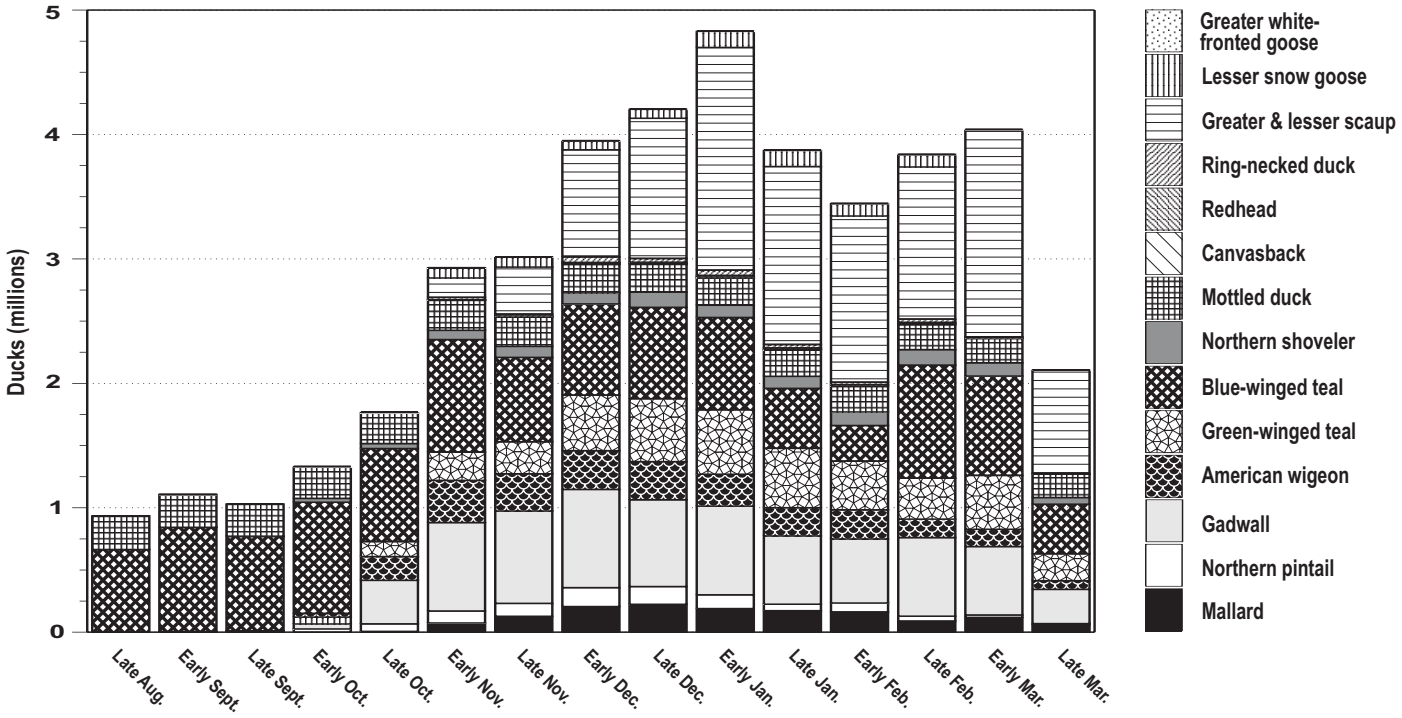


Figure 5. Semimonthly duck population objectives and expected numbers of geese for coastal marsh of the Mississippi River Coastal Wetlands Initiative area.

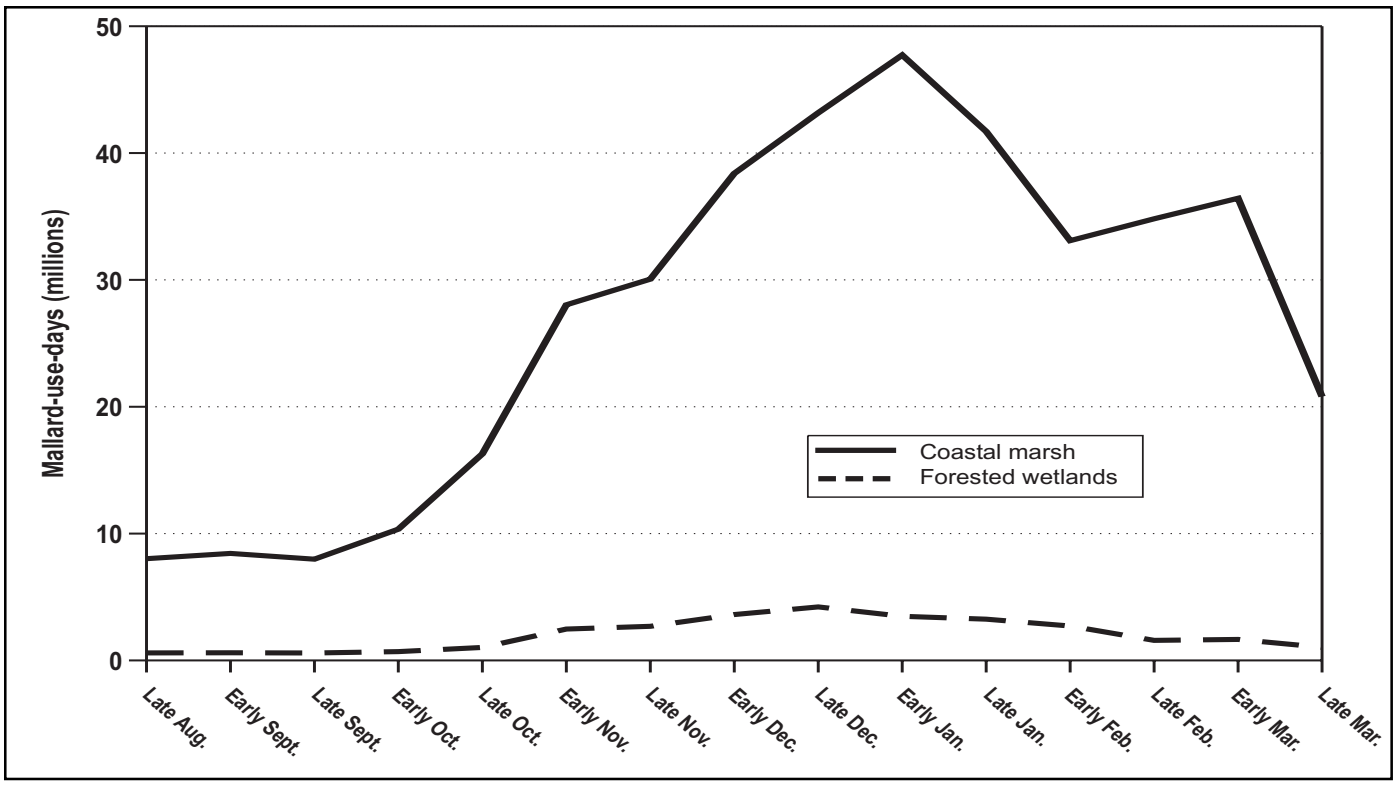


Figure 6. Energetic demand (mallard-use-days) of duck objectives, and expected numbers of geese and wood ducks, in coastal marsh and forested wetlands of the Mississippi River Coastal Wetlands Initiative area.

waterfowl harvest to determine the expected number of wood ducks for parishes of the Mississippi River Coastal Wetlands Initiative area (see Derivation of GCJV Waterfowl Objectives and Migration Patterns section, p. 23), thus resulting in estimates of waterfowl population demand on forested wetland habitats within the Mississippi River Coastal Wetlands Initiative area (Fig. 7).

We modeled the waterfowl energetic demand for this portion of our population objectives based on the dietary energy supply necessary to sustain them. Researchers estimate energetic requirements of mallards to be 290 kcal per day (Petrie 1994), with other species having energetic needs in proportion to their body weight (Kendeigh 1970). We therefore used average body weights of each species in conjunction with semimonthly population objectives to arrive at an energy demand curve, in terms of mallard-use-days, through the wintering waterfowl period (Fig. 6).

Over 543,000 acres of forested wetland habitat are available as foraging habitat for migrating and wintering waterfowl in the Mississippi River Coastal Wetlands Initiative area. Red oak species comprise approximately 30% of bottomland hardwood stands. Foraging values for bottomland hardwoods have been estimated for the Lower Mississippi Valley Joint Venture area (Loesch et al. 1994). We

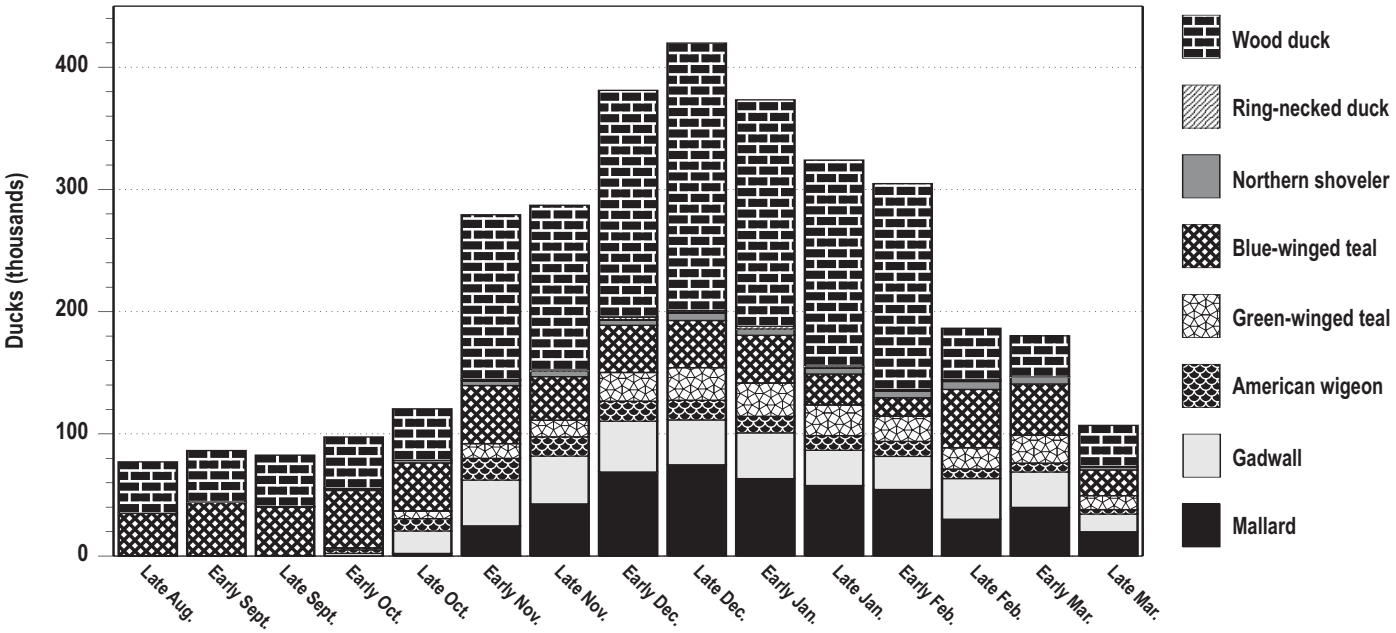


Figure 7. Semimonthly duck population objectives and expected numbers of wood ducks for forested wetlands of the Mississippi River Coastal Wetlands Initiative area.

assumed the relationship between percent red oaks and waterfowl foraging values in bottomland hardwood stands would be similar to the Mississippi River Coastal Wetlands Initiative area, and thus we modeled waterfowl habitat needs for forested wetlands of the Mississippi River Coastal Wetlands Initiative area (Table 2).

Seagrass Beds

Some food density data are available for seagrass beds, and researchers have used existing information to model the carrying capacity of Louisiana shoalgrass beds for redheads (Michot 1997). Chandeleur Sound seagrass beds have been estimated to encompass 19,651 acres, 1,331 acres of which is shoalgrass (Michot 1997). Michot's (1997) published model for redhead carrying capacity suggests that Chandeleur Sound can annually support 22,827 redheads through a given winter. Though this number compares favorably with the region's redhead population objective of 13,731 that is based on 1970's averages, it is less than observed numbers in 1 of those 10 years (i.e., from 1970-79). The model also assumes that all portions of seagrass meadows are equally and totally accessible for redhead foraging, ignoring potential (but untested) effects of disturbance or other factors in limiting redhead accessibility. Observed numbers exceed 80% of the modeled carrying capacity in at least 4 years from 1970 to 1998. The winter following Hurricane Georges, which in 1998 destroyed or buried many of the seagrasses in Chandeleur Sound, saw observed redhead numbers fall to only 2,125, demonstrating the potential for food resource limitation to affect redheads. Combined, these factors suggest the

Table 2. Foraging values, habitat needs, and habitat availability for the Mississippi River Coastal Wetlands Initiative area.

	Foraging value per acre (MUDs[1])	Habitat need (MUDs)	Current[2]		2050 projected		Public ownership[3]	
			Acres	MUDs	Acres	MUDs	Acres	MUDs
Coastal marsh	*	405,320,054[4]	1,683,600	*	1,381,690	*	377,628	*
Forested wetland	62	30,201,263[5]	543,320	33,685,840	311,430	19,308,660	29,774	1,845,988
Seagrass bed	93[6]	1,096,852[6]	19,651	1,823,453[6]	*	*		
Total		436,618,169	2,246,571	*	*	*	407,402	*

***** Unknown.
[1] Mallard-use-days.
[2] 1989 or 1990 acreage estimates.
[3] Refer to Table 3.
[4] Sum of all energetic demands for coastal marsh habitats (Fig. 6).
[5] Sum of all energetic demands for forested wetland habitats (Fig. 6).
[6] Back-calculated from Michot (1997) model.

potential for current habitat conditions to limit redhead populations during some years, and the need to protect the existing habitat base.

Table 3. Estimated coastal marsh and forested wetland habitat that is currently under public ownership in the Mississippi River Coastal Wetlands Initiative area[1].

Land tract[2]	Ownership[3]	Coastal marsh (acres)	Forested wetlands (acres)
Atchafalaya Delta WMA	LDWF	6,000	2,100
Bayou Sauvage NWR	USFWS	22,000	0
Bayou Segnette SP	LOSP	0	400
Big Branch NWR	USFWS	9,000	0
Biloxi WMA	LDWF	39,583	0
Cypremort Point SP	LOSP	43	0
Delta NWR	USFWS	48,800	0
Elm Hall WMA	LDWF	0	2,839
Fairview Riverside SP	LOSP	0	40
Fontainbleau SP	LOSP	1,000	200
Grand Isle SP	LOSP	20	0
Jean Lafitte-Barataria NP	NPS	5,266	2,363
Joyce WMA	LDWF	0	15,609
Lake Boeuf WMA	LDWF	0	670.
Manchac WMA	LDWF	8,325	0
Mandalay NWR	USFWS	4,100	0
Marsh Island SWR	LDWF	76,000	0
Pass a Loutre WMA	LDWF	50,000	0
Pearl River WMA	LDWF	18,560	5,453[4]
Point au Chien WMA	LDWF	35,000	0
St. Bernard SP	LDWF	0	100
St. Tammany SWR	LDWF	1,310	0
Salvador/Timken WMA	LDWF	30,000	0
Terrebonne Barrier Is. SWR	LDWF	1,000	0
Wisner WMA	LDWF	21,621	0
Total		377,628	29,774

[1] Data from 1999 U.S. Shorebird Conservation Plan/GCJV Questionnaire, unless otherwise specified. Data for all Louisiana Office of State Parks sites provided by the Louisiana Office of State Parks. Data for National Park Service site provided by Tommy Michot (U.S. Geological Survey's National Wetlands Research Center). Data for Elm Hall and Lake Boeuf Wildlife Management Areas provided by Louisiana Department of Wildlife and Fisheries. Data for Mandalay National Wildlife Refuge provided by Steve Reagan (U.S. Fish and Wildlife Service).

[2] WMA = Wildlife Management Area, NWR = National Wildlife Refuge, SP = State Park, NP = National Park, SWR = State Wildlife Refuge.

[3] LDWF = Louisiana Department of Wildlife and Fisheries, USFWS = U.S. Fish and Wildlife Service, LOSP = Louisiana Office of State Parks, NPS = National Park Service.

[4] Includes only that portion (approx. 1/3) inside the GCJV boundary.

Habitat Conclusions

Forested wetlands of the Mississippi River Coastal Wetlands Initiative area provide habitat for less than 8% of all ducks, including wood ducks, that occur in the region. The current acreage of forested wetlands is apparently sufficient to meet waterfowl foraging needs at objective population levels, although only about 6% of this acreage is in public ownership (Table 3). Of paramount concern, however, is the 50-year projected loss of forested wetlands (regardless of ownership status) to levels below that which meets foraging needs. This projected loss highlights the need to support large-scale hydrologic modifications to restore the isohaline imbalance that is threatening these habitats and their

ability to meet regional waterfowl needs.

Coastal marsh of the Mississippi River Coastal Wetlands Initiative area provides habitat for over 90% of all waterfowl that occur in the region. We lack food density data for these habitats, precluding a quantitative assessment of the carrying capacity of available coastal marsh habitats. Nonetheless, whatever the current capacity to support waterfowl, it will surely decrease as 50-year projections estimate that only about 80% of the acreage that exists now will persist, even given current restoration efforts. Until we are able to quantify these food resources, a conservative approach to waterfowl management requires that we maintain conservation of marshes as a high priority within the Mississippi River Coastal Wetlands Initiative area.

Seagrass beds of Chandeleur Sound appear to be capable of sustaining redhead population objectives, but there is potential for redheads to be food limited in that system in some years. Over 90% of continental redhead populations winter in only four areas, one of which is Chandeleur Sound (Michot 2000). The limited geographical distribution of redheads, coupled with their heavy reliance on a single prey plant species (shoalgrass), dictates a very conservative approach to the conservation of habitats they rely upon. There are few options for actively conserving seagrass beds of Chandeleur Sound, but available maintenance actions should be undertaken.

Specific Activities

The wetland habitat objectives of the Mississippi River Coastal Wetlands Initiative will be addressed through various projects that focus on coastal marsh, forested wetlands, and seagrass meadows. Coastal wetland projects will involve protecting critical shorelines and banks, improving or restoring more natural hydrological conditions (to stabilize water and salinity levels and to reduce tidal scour), trapping sediments (to accelerate natural wetland building), and creating marsh with dredged material. Many of these projects will be designed to address localized problems, while others will be designed to provide benefits to coastal wetlands far beyond the construction footprint. The focus of projects will be reducing interior wetland loss, rebuilding wetlands in open water areas, and maintaining the geologic framework of the coast by addressing shoreline and bank erosion. Additionally, partners will initiate activities described herein as other opportunities become available. An evolving package of actions designed to meet some of the Mississippi River Coastal Wetlands Initiative/GCJV objectives as well as contribute to the

American wigeon pair.

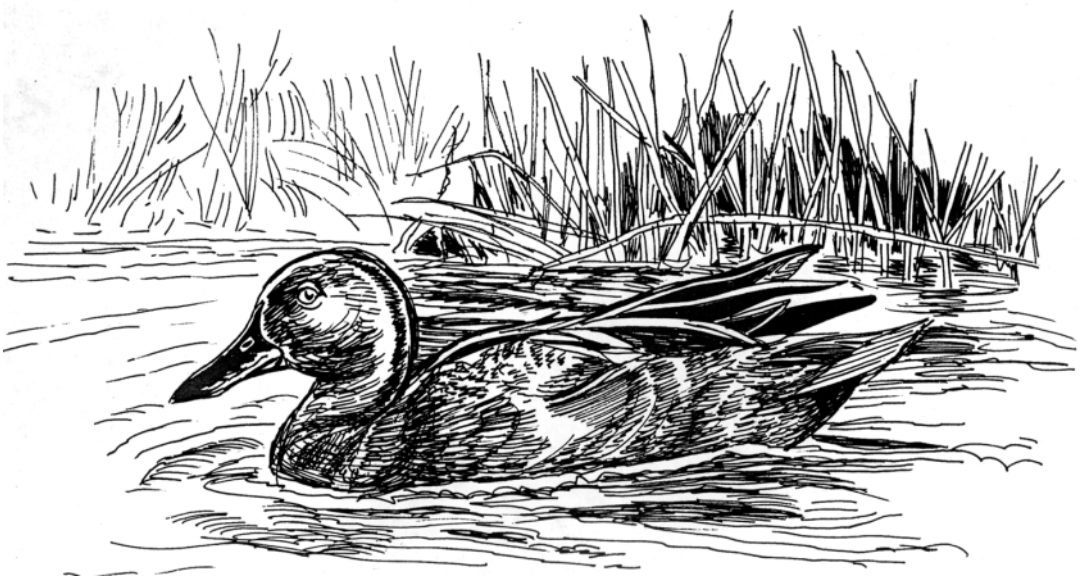
fulfillment of the NAWMP goals has been developed and will be continually updated.

Other Programs

We recognize and support other conservation efforts that contribute to goals of this plan. Coastal marsh projects implemented under the Coastal Wetlands Planning, Protection and Restoration Act contribute significantly to the maintenance and restoration objectives of this plan through the Louisiana planning effort known as "Coast 2050." Similarly, larger scale projects implemented through the Water Resources Development Act by the U.S. Army Corps of Engineers will also contribute to goals set forth in this plan.

Communication and Education

Public awareness of the importance of the Gulf Coast to waterfowl and other renewable resources is key to the success of the GCJV. Communication efforts will be developed to educate decision makers, resource managers, landowners, conservation organizations, and the general public about wetland conservation in the Mississippi River Coastal Wetlands Initiative area.



Relationship to Evaluation Plan

Objectives and strategies outlined in this document represent a compilation of the best available information regarding the habitat needs of waterfowl in this region. However, information gaps require numerous assumptions about both the basic framework for planning habitat conservation (i.e., food limitation) and specific variables used in energetic modeling of habitat needs (e.g., relative importance of habitat types by species). Testing of the most critical of these assumptions will be addressed in the GCJV Evaluation Plan, which is being developed simultaneously with this plan. The GCJV Evaluation Plan will provide a mechanism for feedback to, and refinement of, Initiative Area Implementation Plans. These plans will therefore be updated periodically, as evaluation feeds the planning and implementation processes.

Northern shovelers and blue-winged teal.

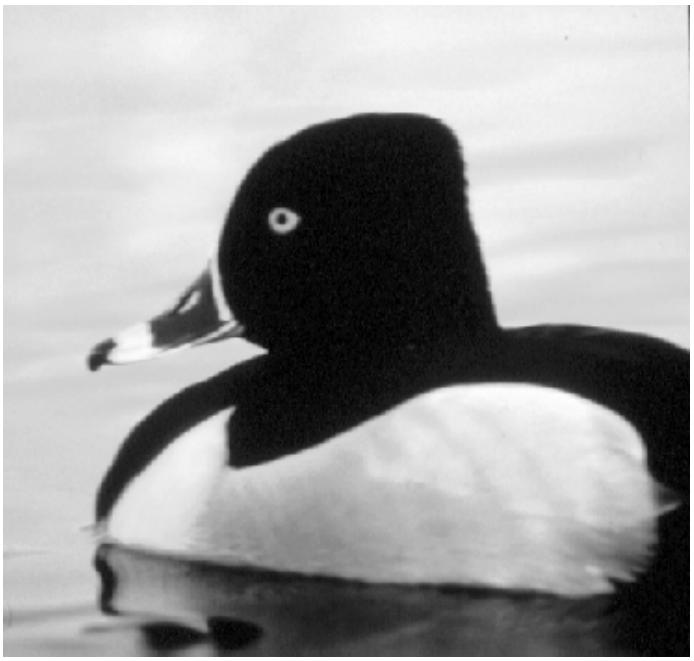
Derivation of GCJV Waterfowl Objectives and Migration Patterns

Midwinter Duck Population Objectives

Although the coordinated midwinter survey is an inaccurate count of total wintering birds, and not corrected for visibility bias, it provides a reasonable approximation of the relative distribution of birds across broad regional and temporal scales. Therefore, we used averages from the 1970-79 midwinter surveys for each species to determine the proportion of surveyed ducks that occurs in each of the initiative areas. (For greater and lesser scaup, offshore counts were excluded due to inconsistent survey coverage, resulting in "inland-only" scaup objectives.) We then applied those species-specific proportions to the NAWMP continental breeding population objectives for each species to arrive at the number of birds each initiative area should supply to the breeding population. We assume 10% mortality between midwinter (January) and breeding (May) periods to arrive at midwinter objectives (Table 1).

Using mallards as an example, during 1970-79, 42.9% of all continental mallards counted during the midwinter survey were in the Mississippi Flyway (see Fig. 3 for a similar example). The NAWMP continental breeding population objective for mallards is 11 million, so we estimate the portion of the continental breeding population objective from the Mississippi Flyway to be 42.9% of that, or 4.72 million. Expanding this number to account for 10% mortality between January and May yields a midwinter objective of 5.24 million in the Mississippi Flyway. Because 9.8% of all Mississippi Flyway mallards were counted in the Louisiana Chenier Plain, we applied that percentage to the flyway goal and obtained a midwinter population objective of about 516,000 for mallards in the Louisiana Chenier Plain. This method yields midwinter objectives for most species of ducks that commonly occur in the GCJV area (Table 1).

Exceptions to this method include derivations for blue-winged teal and redhead objectives, and estimation of the expected number of mottled ducks. For blue-winged teal, the continental breeding population was first reduced by 79% to account for the proportion estimated to winter outside the range of the U.S. midwinter survey, mainly in Mexico and Central and South America.



Male ring-necked duck.

Population objectives for redheads were determined directly from average winter population estimates from the Special Redhead Cruise Survey for the same time period (1970-79). Using direct estimates from aerial winter surveys is appropriate for determining objectives for redheads but not other ducks, because (1) wintering redheads occur almost exclusively in known locations of offshore seagrass habitat with good visibility, (2) visibility bias has been estimated and found negligible for portions of this special survey, and (3) redhead habitats are not consistently surveyed during the midwinter survey, precluding the methodology applied for most species.

Male American wigeon.

To estimate the number of mottled ducks expected to occur during winter, we used mark-recapture analyses of direct recoveries from bandings in Louisiana and Texas during 1994-97. Preseason population estimates were derived from the assumption that the ratio of the total population to the total harvest (U.S. Fish and Wildlife Service estimate) equals the ratio of the banded population to the banded harvest (direct recoveries/band reporting rate estimate. Band reporting rates are assumed to be 33% for 1994-95 and 59% for 1996-97). Preseason population estimates were then averaged, and an estimated fall/winter mortality rate of 30% was assumed to be evenly distributed September through March. The resulting midwinter estimate was then apportioned to initiative areas by the midwinter survey (Table 1).

Though not actually an objective, recent wood duck numbers are used in some initiative areas to augment energetic models depicting habitat needs in forested wetlands. These recent population size approximations are derived from a combination of harvest and harvest rate estimates. The Harvest Surveys Section of the U.S. Fish and Wildlife Service (Laurel, MD) provided wood duck harvest data by county for 1990-99. Wood duck harvest rates are approximated to be 10%. This is based on both band recovery rates and estimates of band reporting rate (Table 4).

Migration Patterns

Louisiana migration patterns for ducks were determined by using periodic coastwide aerial surveys along established transects that generally were flown one to two times per month September through March, 1970-98 (Louisiana Department of Wildlife and Fisheries coastal transect survey,

Table 4. Estimated wood duck harvest, harvest rates, and population size(s) for the Mobile Bay, Coastal Mississippi Wetlands, and Mississippi River Coastal Wetlands (southeast Louisiana) Initiatives.

Initiative Area	Number harvested (10-yr average)	Harvest rate	Expected peak population
Mobile Bay	1,300	10%	13,000
Coastal Mississippi Wetlands	530[1]	10%	5,300
Mississippi River Coastal Wetlands (southeast Louisiana)	21,900	10%	219,000

[1] Due to low sample size, we used the upper range of harvest estimates from 1990-99.

unpublished data). Chandeleur Sound, the primary redhead area in Louisiana, is not covered by these coastal transects, so for Louisiana redheads we instead used 1987-92 periodic redhead surveys from that region (Thomas C. Michot, U.S. Geological Survey, unpublished data). Each survey was assigned to a half-month period. For each species, each survey of a given year was expressed as a proportion of that year's peak. These proportions were averaged across all years to yield the average proportion of the annual peak for each half-month period. All proportions were then expressed relative to the midwinter (January) proportion (see Migration Chronology for Waterfowl Species of GCJV Initiative Areas section, p. 26).

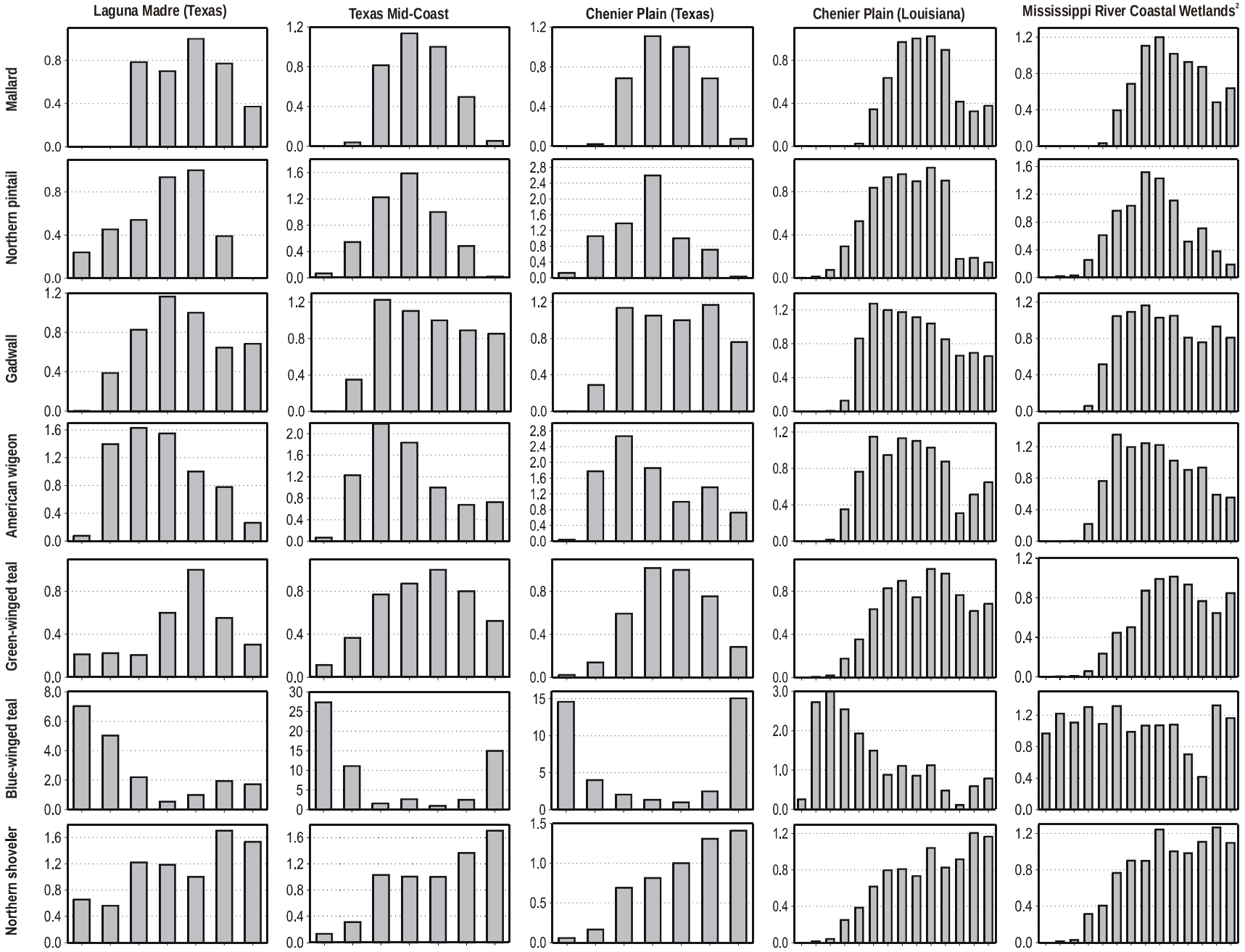
For Texas, aerial surveys of federal refuges and select other properties provide the basis for determining migration patterns (U.S. Fish and Wildlife Service's Coastal Waterfowl Survey Data, unpublished data). These monthly Texas surveys were conducted September through March of 1984-97, and data from all sites that were consistently surveyed within a given year were used. Analyses were conducted as above, except each survey represented an entire month (see Migration Chronology for Waterfowl Species of GCJV Initiative Areas section, p. 26).

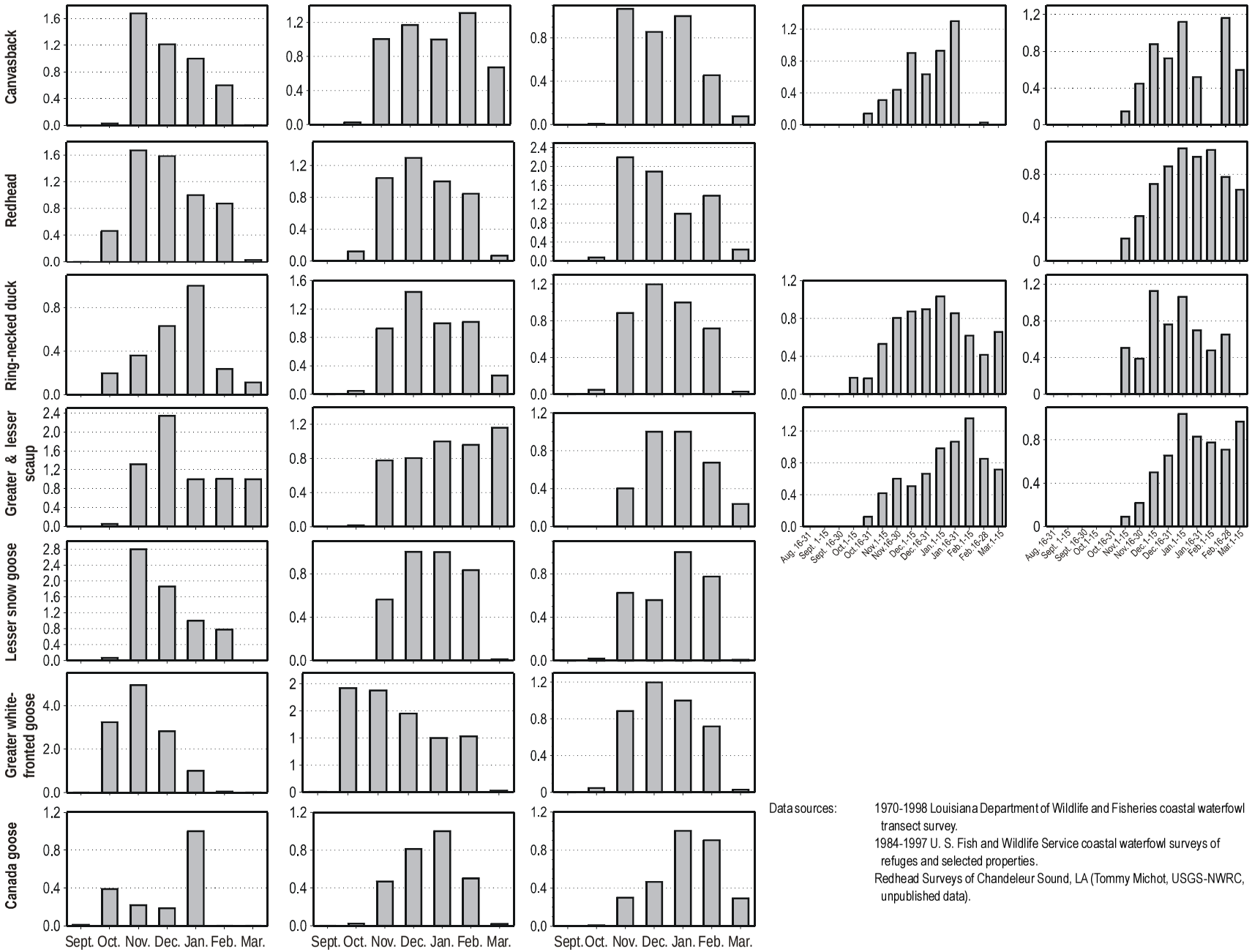
For wood ducks, we used fall and spring migration data depicted for the Gulf Coast in Bellrose and Holm (1994) to estimate the relative proportion of the annual peak in each semimonthly period.

Multiplying these semimonthly proportions by the midwinter population objectives yields semimonthly population objectives by species and initiative area (Fig. 4). Because Louisiana surveys were never conducted in late March, we assumed late March values for all species were 50% of early March values. Because Texas surveys were never conducted in late August, we assumed late August blue-winged teal values were 15% of early September values. Because geese are not periodically surveyed in Louisiana, we applied migrational information from the Texas Chenier Plain to all eastward initiative areas. For the Coastal Mississippi Wetlands and Mobile Bay Initiative areas, we applied duck migrational information from the Mississippi River Coastal Wetlands Initiative area (southeast Louisiana).

Blue-winged teal males.

Migration Chronology for Waterfowl Species of GCJV Initiative Areas[1].





Data sources: 1970-1998 Louisiana Department of Wildlife and Fisheries coastal waterfowl transect survey.
1984-1997 U. S. Fish and Wildlife Service coastal waterfowl surveys of refuges and selected properties.
Redhead Surveys of Chandeleur Sound, LA (Tommy Michot, USGS-NWRC, unpublished data).

[1]Average proportion of the annual peak, relative to January (midwinter) survey. Data are not available for Coastal Mississippi Wetlands and Mobile Bay Initiative areas.
[2]Southeast Louisiana.

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Appendix

Scientific Names of Plants and Animals Mentioned in This Plan

I. Plants alphabetical by common name.

Common Name	Scientific Name
Alligatorweed	*Alternanthera philoxeroides*
Bulltongue arrowhead	*Sagittaria lancifolia*
Coastal waterhyssop	*Bacopa monnieri*
Common reed	*Phragmites australis*
Maidencane	*Panicum hemitomon*
Manateegrass	*Syringodium filiforme*
Needlegrass rush	*Juncus roemerianus*
Olney bulrush	*Schoenoplectus americanus*
Pondweed	*Potamogeton* sp.
Red oak	*Quercus* spp.
Saltmeadow cordgrass	*Spartina patens*
Seashore saltgrass or inland saltgrass	*Distichlis spicata*
Shoalgrass	*Halodule wrightii*
Smooth cordgrass	*Spartina alterniflora*
Southern waternymph	*Najas guadalupensis*
Spikerush	*Eleocharis* sp.
Star grass	*Cynodon plectostachyus*
Turtlegrass	*Thalassia testudinum*
Widgeongrass	*Ruppia maritima*

II. Waterfowl alphabetical by common name.

Common Name	Scientific Name
American black duck	*Anas rubripes*
American wigeon	*Anas americana*
Black-bellied whistling duck	*Dendrocygna autumnalis*
Blue-winged teal	*Anas discors*
Canada goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Fulvous whistling duck	*Dendrocygna bicolor*
Gadwall	*Anas strepera*
Greater scaup	*Aythya marila*
Greater white-fronted goose	*Anser albifrons*
Green-winged teal	*Anas crecca*
Lesser scaup	*Aythya affinis*
Lesser snow goose	*Chen caerulescens*
Mallard	*Anas platyrhynchos*
Northern pintail	*Anas acuta*
Northern shoveler	*Anas clypeata*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Ross' goose	*Chen rossii*
Wood duck	*Aix sponsa*

III. Other animals alphabetical by common name.

Common Name	Scientific Name
Alligator	*Alligator mississippiensis*
Muskrat	*Ondatra zibethicus*
Nutria	*Myocastor coypus*

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